Intestinal Health and Necrotic Enteritis in Broilers

MISSISSIPPI STATE UNIVERSITY EXTENSION

The gastrointestinal (GI) tract of the commercial broiler chicken is constantly exposed to a wide variety of potentially harmful factors. These factors can have serious effects on the GI tract condition and negatively affect health and performance of birds in commercial broiler flocks. Enteric diseases are those related to the intestine. They are a major issue to the poultry industry because of lost productivity, increased mortality, and concerns over animal welfare. The microflora population that lives in the GI tract is a mixture of bacteria and other microorganisms such as fungi and protozoa.

Bacteria make up the largest portion of this population. Different bacteria have different food preferences, so the microbial population of the GI tract is largely affected and determined by what the bird eats. In addition, there is significant diversity in bacterial populations at various locations along the GI tract, and populations tend to increase from the front to the back of the tract (Richards et al., 2005). In other words, each region of the GI tract has its own unique microbial population, and populations become more complicated as the birds age.

Microbes come with a cost to the bird. The cost may include competition for food and an ongoing inflammatory response in the GI tract. But **not all intestinal microbes are bad**. The effects of microbial activities can be classified as either potentially harmful or potentially beneficial. Potential harmful effects include localized or systemic infections and toxin formation. Beneficial effects can include vitamin production, stimulation of the immune system through nonpathogenic mechanisms, and inhibition of the growth and establishment of harmful microbial populations (Jeurissen et al., 2002), also known as competitive exclusion.

Clostridium perfringens is one of the normal gut microflora of poultry. This anaerobic bacteria is found nearly everywhere, including in intestinal contents, feed, feces, litter, dust, and soil. The bacteria is gram positive, spore-forming, highly prolific, and toxigenic. ***C. perfringens* is the causative agent of necrotic enteritis** (**NE**). It is estimated that NE affects up to 40 percent of commercial broiler flocks and costs the U.S. broiler industry five cents per bird (McDevitt et al., 2006).

C. perfringens infections may occur as clinical or subclinical diseases. The clinical form of NE is associated with high mortality that, if left untreated, may reach 1 percent per day and possibly 10–40 percent of an infected flock (Boulianne, 1999). However, it is the subclinical form that often goes undetected and, therefore, untreated. Its effect on production (through malabsorption, reduced growth rate, impaired feed conversion, etc.) and welfare likely causes a far greater impact on performance and profitability than the clinical disease.

Necrotic enteritis is known to affect broilers, laying hens, turkeys, and quail. The clinical form is **most commonly seen in two- to five-week-old broilers**, where symptoms may include severe depression, decreased appetite, dark-colored diarrhea, closed eyes, and ruffled feathers (Durairaj and Clark, 2007). Symptoms are short-lived because affected birds die quickly and deteriorate rapidly from the inside out. Upon autopsy, it may appear the bird has coccidiosis (and coccidiosis is often a predisposing factor), but the intestines are often inflated with gas and may contain a foul-smelling brown fluid.

Broiler growers should observe birds closely at around 17–18 days of age because this is often when outbreaks of NE occur. Typically, this is also near the time that diets are switched from starter feed to grower feed, so it may be that opportunistic *C. perfringens* takes advantage of this transitional period in the intestinal environment and proliferates. This could be in response to changes in pH, diet composition (non-starch polysaccharide content), enzyme supplementation, or immune system response (McDevitt et al., 2006).

Be aware that any stress on the bird can alter the intestinal environment. This is especially true of the poultry house environment and litter conditions. Good, **sound management practices** will help limit predisposing birds to conditions where *C. perfringens* can more easily gain a foothold. Should you have a flock that breaks out with NE, **prompt and regular collection of dead birds becomes a necessity**, requiring even more vigilance than your routine collection. Dead birds will decompose rapidly, and should cannibalism occur, other birds in the flock will be exposed to very large numbers of *C. perfringens*, further spreading the disease. Dahiya et al. (2006) composed a list of risk factors for NE into five broad categories:

- *Eimeria* infection
- Removal of coccidiostats or antibiotic growth promoters from poultry feed
- Environmental and management conditions
- Physiological stress and immunosuppression
- Nature and form of diet

Integrators typically use three basic strategies to control NE in broiler flocks. These include: **1)** creating an immune response (vaccination), **2)** reducing pathogens (biosecurity and sanitation procedures), and **3)** modifying diets and feed additives. Use of live anticoccidial vaccines is increasing in the poultry industry. However, the topic is somewhat controversial because in some studies, it appears coccidiosis, especially *Eimeria* species, may predispose birds to clostridial enteritis; while other studies show this may not be the case.

For example, Williams (1994) and Williams and Andrews (2001) reported that coccidiosis vaccination may cause mild coccidial lesions in some birds, but those lesions were not severe enough to predispose immunized birds to necrotic enteritis. In contrast, Williams et al. (2003) examined relationships between coccidiosis, anticoccicial vaccines, and necrotic enteritis in broiler chickens and observed that vaccination prevented coccidial lesions that otherwise may lead to necrotic enteritis.

Two important dietary factors seem to predispose broiler chickens to NE. The first is **cereal grain type**. For example, wheat, rye, and barley increase the viscosity of digesta, prolong intestinal transit time, and increase incidence of NE (Dahiya et al., 2006). **Protein level and source** is the second factor. High levels of protein from animal sources may predispose birds to NE (Kocher et al., 2003). **Method of feed processing** also appears to be an important precursor for NE. For example, Branton et al. (1987) found that NE mortality was increased in birds fed hammer-mill-ground feed compared with more coarsely ground roller-mill feed.

It has been suggested that **non-starch polysaccharides** (**NSP**) from plant sources may increase viscosity of the intestinal contents and reduce passage rate (Yegani and Korver, 2008). However, the exact mechanism(s) behind the effect of cereal grain type on *C. perfringens* populations in the intestinal tract are unknown. Presence of NSP in the diet could encourage growth of clostridia and simultaneously suppress the growth of other "good" bacteria such as *Lactobacillus* (Annett et al., 2002). Integrators concerned with increased levels of NSP in the diet often choose to use commercially available enzymes to break down NSP and reduce digesta viscosity, increase passage rate, and reduce the bacterial population in the small intestine.

Nutritional stress can result from diets that lack balanced nutrients, predisposing birds to clostridial overgrowth and NE. For example, birds will consume more feed if the energy-to-protein ratio of the diet is low, thereby exceeding their requirements for protein and causing an increase in the nitrogen content of the digesta and manure (McDevitt et al., 2006). An increased proportion of undigested feed in the manure is associated with an imbalance of amino acids, higher dietary nitrogen content, and reduced protein digestibility. Naturally, increased excretion is accompanied by increased water intake. Without adequate ventilation and proper management of the house environment, this may lead to wet litter. In turn, **wet litter provides an ideal opportunity for *Clostridium* to proliferate.**

In addition, besides important nutrients such as energy, protein, and fat, feed is made up of many other components that cannot be digested by poultry, including mannans, cellulose, lignin, and phytic acid. Indigestible ingredients may cause digestive stress, allowing overgrowth of pathogenic bacteria in the GI tract. These compete for energy and protein, reducing the nutrients available to support bird growth (Dahiya et al., 2006). As mentioned earlier, integrators have been able to counteract some of this problem by incorporating various feed enzymes into the diet, although the exact mechanism responsible remains a mystery.

With the phasing out of antibiotic growth promoters from broiler diets, much of the recent dietary research has focused on the use of **alternative feed additives** to inhibit the growth of *C. perfringens*. There is increasing interest in the use of essential oils, herbs, and spices in the diet to lessen or prevent NE. These ingredients have been used in alternative medicine and natural therapies for years. However, their potential usefulness in the poultry industry has only recently become more apparent. For example, oregano essential oil was shown to be as effective as Salinomycin in reducing the severity of coccidiosis in broilers (Giannenas et al., 2003). In addition, Mitsch et al. (2004) reported that specific blends of essential oil compounds can control the proliferation of *C. perfringens* in the broiler intestine and may reduce the risk of NE.

Researchers around the world currently are investigating various feed additives to offset the reduced use or complete withdrawal of antibiotics from feed. This is a problem not only in the United States. In fact, European countries have been dealing with the issue longer than U.S. producers have. Their experiences should help us understand what to expect and how to deal with reduced or restricted use of feed antibiotics. Unfortunately, a good alternative to in-feed antibiotics has not yet been found, and it is unlikely that a single, cost-effective solution will be discovered. The problem is complex and will have to be attacked on numerous fronts at once to be adequately addressed.

Management at the farm level (litter quality and composition, lighting programs, stocking density, drinker management, and dietary feed management) will be an important factor. In addition, further dietary research is needed on amino acid profile and grain source, as well as on promising alternatives to antibiotic growth promoters, such as **enzymes, essential oils, herbs, spices, probiotics, and prebiotics**. Continued research is necessary to successfully combat the NE issue in a manner acceptable to the poultry industry, its growers, and the consuming public.

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